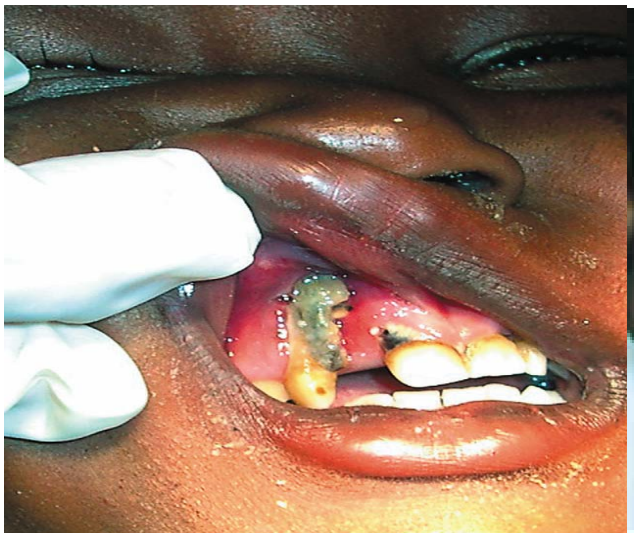

NOMA

Skrevet av: Airan Rastegarian og Abshir Jama.

Studentprosjekt ved Det odontologiske fakultet, Universitetet i Oslo 2006

Veileder:Tore Bjørnland

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INTRODUCTION

What is Noma?

The word noma, also known as cancrum oris, derives from the Greek word, *nome*, meaning a pastureland or grazing; here used as a continuously spreading ulcer.
Noma is an acute and ravaging gangrenous infection affecting the face. The victims of noma are mainly young children living in extreme poverty and chronic malnutrition. Other predisposing factors are debilitation caused by measles or other diseases, and poor oral hygiene *(Alexander Fieger et al. 2003).*

Noma begins with ulcers in the mouth. If left untreated, it spreads throughout the soft and hard tissue of the face. Patients die within 1-2 weeks as a result of sepsis. *(Klaas W. Marck 2003)*. It is estimated that the mortality rate reaches up to an alarming 90%. As for the survivors, their lives will never be the same and they will suffer three main afflictions: facial disfigurement, functional impairment and social outcast.

The first available data on the incidence and prevalence of noma are those reported by WHO in 1998, which estimated a worldwide incidence of 140,000 cases per year with prevalence in 1997 of 770,000 people living with noma sequelae, and most cases occur in Africa in sub-Saharan countries *(Denise Baratti-Mayer et al. 2003)*

This student-project is a review of articles about Noma; where we mainly discuss the history, etiology, pathology and treatment of this disease. The articles are acquired from Pubmed and Ovid. We started to get interested in the subject, while we were reading earlier projects by students. We came across one review which described noma, but we were not fully satisfied, so we wanted to get more information about noma. That's why we decided to write more of this subject.

HISTORY

The disease noma was known in classical time as can be read in Celsus' De Medicina, and this was also known to Hippocrates, Galen and Aretaeus of Cappadocia. The first description of noma as a clinical entity originated from Carolus Battus, a surgeon in The Nederlands in 1595, in the "Handboeck der Chirurgijens". But it was Cornelis van de Voorde, a surgeon too from The Nederlands who used the word noma to specifically indicate quickly spreading gangrene in the humid soft tissues (almost always the mouth) of children, in his book "Nieuw Lichtende Fakkel der Chirurgie of Hedendaagze Heel-Konst (Modern Torch of Surgery) (1680). Noma had been widespread throughout Europe for many centuries and also reported in North American writings of the 18th and 19th century. *(Enwonwu et al.1999)*

Up to the end of eighteenth century the surgeons/authors mentioned only conservative treatment of noma, recommending their personal medication and washings and extraction of loose teeth *(Klaas W. Marck 2003)*. By the end of 19th century, noma had virtually disappeared from Western Europe and North America as a result of improved nutrition and conditions of hygiene among the poor people. Ps. Noma cases were also found in Nazi concentration camps where victims died as a result of malnutrition.

PATHOLOGY

The sequlae of noma are well-known, but the initial stage of the disease remains difficult to characterize, because few patients seek medical care during the acute phase. Therefore clinical descriptions of the acute stage are rare and imprecise. Parents of some affected children mention fever, apathy, gingival bleeding, lesions of the oral mucosa, edema of the face and fetid odour. Some of the researchers have also mentioned the presence of s pot or papule that rapidly forms an ulcer with subsequent bone exposure. *(Denise Baratti-Mayer et al 2003)* There has been proposed a possible relation between acute necrotizing gingivitis (ANG) and noma. The present expert consensus is that ANG is a precursor of noma. (fig 1)

NECROTIZING PERIODONTAL DISEASE

Necrotizing gingivitis is one of the most severe inflammatory periodontal disorders caused by plaque bacteria. The necrotizing disease usually run an acute course and therefore the term acute is often included in the diagnosis; Acute necrotizing gingivitis (ANG) (Horning and Cohen 1995)

The necrotizing periodontal disease has been mentioned also as "acute necrotizing ulcerative gingivitis" (ANUG) (Pickard 1973, Johnson and Engel 1986, Horning and Cohen 1995).

NG should be limited to lesions only involving gingival tissue with no loss of periodontal attachment (Riley et al. 1992). Most often, however, the disease results in loss of attachment (MacCarthy and Claffey 1991), and a more correct term in cases with loss of attachment is necrotizing periodontitis (NP), which include the gingival, periodontal ligament and the alveolar bone. Further progression to include tissue beyond the mucogingival junction is characteristic of necrotizing stomatitis (NS) (Williams et al. 1990).

NS has features in common with the far more serious cancrum oris, also denoted NOMA.

CLINICAL CHARACTERISTICS

Development of lesions

NG is an inflammatory destructive gingival condition, characterized by ulcerated and necrotic papillae and gingival margins resulting in a characteristic punched-out appearance. The ulcers are covered by a yellowish-white or grayish slough, which has been termed "pseudomembrane", which bears little resemblance to a membrane. It consists primarily of fibrin and necrotic tissue with leukocytes, erythrocytes and masses of bacteria. The necrotizing lesions develop rapidly and are painful, but when the necrotic areas are relatively few and small, pain is usually moderate. Bleeding is readily provoked. This is due to the acute inflammation and necrosis with exposure of the underlying connective tissue. Bleeding may start spontaneously as well as in response to even gentle touch. In early phases of the disease lesions are typically confined to the top of a few interdental papillae (fig 2c). The first lesions are often seen interproximally in the mandibular anterior region, but they may occur in any interproximal space. Usually the papillae rapidly swell and achieve a rounded contour. The zone between the marginal necrosis and the unaffected gingival usually exhibits a well-demarcated narrow erythematous zone, sometimes referred to as the linear erythema. This is an expression of hyperemia due to dilation of the vessels in the gingival connective tissue in the periphery of the necrotic lesions. (fig 2a)

Interproximal craters

The gingival necrosis develops rapidly and within a few days the involved papillae are often separated into one facial (buccal) and one lingual portion with an interposed necrotic depression, a negative papilla, between them. The central necrosis produces considerable tissue destruction and a regular crater is formed. At this stage of the disease process usually involves the periodontal ligament and the alveolar bone, and loss of attachment is now established. This diagnosis of the disease process of the disease is consequently NP (fig 3).
Along with the papilla destruction, the necrosis usually extends laterally along the gingival margin at the oral and/or facial surfaces of the teeth. (fig.2 a, b)
Progression of the interproximal process often results in destruction of most interdental alveolar bone.(fig.3) In more advanced cases, pain is often considerable and may be associated with a markedly increased salivary flow. As a result of pain it is often difficult for patients to eat, and a reduced food intake may be critical to HIV-infected patients and also it increases the risk for developing to Noma.

Sequestrum (sekvest) formation

The disease progression may be rapid and result in necrosis of small or large parts of the alveolar bone. Such development is particularly evident in immunocompromised patients. The necrotic bone, denoted a sequestrum, initially is irremovable but after some time becomes loosened. A sequestrum may not only involve interproximal bone but also include adjacent facial and oral cortical bone. (fig 4a)

Involvement of alveolar mucosa.

When the necrotic process progresses beyond the mucogingival junction, the condition is denoted NS (Williams et al. 1990) (figs 4 a, b and 5). The severe tissue destruction characteristic of this disease is related to seriously compromised immune functions typically associated with HIV infection and malnutrition (fig 6). Importantly it may be life-threatening. NS may result in extensive denudation of bone, resulting in major sequestration with the development of oro- antral fistula and osteitis (San Giacomo et al. 1990, Felix et al. 1991)

Swelling of lymph nodes

Swelling of the regional lymph nodes may occur in NPD but is particularly evident in advanced cases. Such symptoms are usually confined to the submandibular lymph nodes, but the cervical lymph nodes may also be involved. In children with NP, swelling of lymph nodes and increased bleeding tendency are often the most pronounced clinical findings (Jimenez and Blair 1975).

Fever and Malaise

Fever and malaise is not a consistent characteristic of NP. Some investigations indicate that elevated body temperature is not common in NG and that, when present, the elevation of body temperature is usually moderate (Grupe and Wilder 1956, Goldhaber and Gibbon 1964, Shields 1977, Stevens et al. 1984). A small decrease in body temperature in NG has even been described.

Oral Hygiene

The oral hygiene in patients with NPD is usually poor. Moreover, brushing of teeth and contact with the acutely inflamed gingival is painful. Therefore, large amounts of plague on the teeth are common, especially along the gingival margin. A thin whitish film sometimes covers parts of the attached gingival (fig 7). This film is characteristic finding in patients who have neither eaten nor performed oral hygiene for days. It is composed of desquamated epithelial cells and bacteria in a meshwork of salivary proteins. It is easily removable.

Acute and recurrent forms of necrotizing gingivitis and periodontitis

In most instances the course of the diseases is acute, as characterized by the rapid destruction of the periodontal tissue. However, if inadequately treated or left untreated, the acute phase may gradually subside. The symptoms then become less unpleasant to the patient, but the destruction of the periodontal tissues continues, although at a slower rate, and the necrotic tissues do not heal completely. Such a condition has been termed chronic necrotizing gingivitis, or periodontitis in the case of attachment loss (fig 8). The necrotizing lesions persist as open craters, frequently with a content of subgingival

calculus and bacterial plaque. Acute exacerbations with intervening periods of quiescence may also occur. In recurrent acute phases, subjective symptoms again become more prominent and necrotic ulcers reappear. Here we use the term recurrent to describe this category of necrotizing disease (Johnson and Engel 1986). Recurrent forms of NG and NP may produce considerable destruction of supporting tissues. The most pronounced tissue loss usually occurs in relation to the interproximal craters.

HISTOPATHOLOGY

Histopathologically, NG lesions are characterized by ulceration with necrosis of epithelium and superficial layers of the connective tissue and an acute, not specific inflammatory reaction (fig 9). An important aspect is the role of the microorganisms in the lesions, because they have been demonstrated not only in the necrotic tissue components but also in vital epithelium and connective tissue.
The surface cover of yellowish-white or grayish slough, which can be observed clinically, in the light microscope, appears to be meshwork of fibrin with degenerated epithelial cells, leukocytes and erythrocytes, and by bacteria and cellular debris. At the ultrastructural level, bacteria of varying sizes and forms including small, medium-sized and large spirochetes have been revealed between the inflammatory cells, the majority of which are neutrophilic granulocytes. Moreover, in presumably vital parts of the surface epithelium, compact masses of spirochetes and short, fusiform rods have been found intercellularly.
The vital connective tissue in the bottom of the lesion is covered by necrotic tissue, characterized by disintegrated cells, many large and medium-sized spirochetes, and other bacteria which, judging from their size and shape may be fusobacteria. In the superior part of the vital connective tissue as characterized by intact tissue components, the tissue is infiltrated by large and medium-sized spirochetes, but no other microorganisms have been seen. In the vital connective tissue the vessels are dilated. They also proliferate to form granulation tissue, and the tissue is heavily infiltrated by leucocytes. As always in acute processes the inflammatory infiltrate is dominated by neutrophils (figs.9 +10). In the deeper tissue we find large members of monocytes and plasmacells (Listgarten 1965, Heylings 1967)

MICROBIOLOGY

Microorganisms isolated from necrotizing lesions:
Microbial samples from NP-disease (NPD) lesions have demonstrated a constant and a variable part of the flora.
The "constant flora" primarily contained:

- Treponema sp.
- Selenomonas sp.
- Fusobacterium sp.
- B. melaninogenicus ssp.

- P. intermediate

And the "variable flora" consisted of a heterogeneous arry of bacterial types (Loesche et al. 1982).
The microorganisms associated with NG are also harbored by healthy mouths and mouths with gingivitis or periodontitis (Johnson and Engel 1986)

Pathogenic potential of microorganisms.

The knowledge of the pathogenic mechanisms by which the bacterial flora produces the tissue changes characteristic of NPD is limited. However, several of the pathogenic mechanisms which have been associated with chronic gingivitis and periodontitis may also be of etiologic importance in the necrotizing forms of the diseases. An important aspect in the pathogenesis of the disease is the capacity of the microorganisms to invade the host tissues. Among the bacteria isolated from necrotizing lesions, spirochetes and fusiform bacteria can in fact invade the epithelium (Heylings 1967). The spirochetes can also invade the vital connective tissue (Listgarten 1965). Both organisms can also liberate endotoxins (Mergenhagen et al. 1961, Kristoffersen and Hofstad 1970). Endotoxins cause tissue destruction both directly and indirectly (Wilton and Lehner 1980). Necrosis is a prominent feature in the so called "Schwartzman reaction", which is caused by endotoxins.

DIAGNOSIS

The diagnosis of NG, NP and NS is based on clinical findings as described above. The patient has usually noticed pain and bleeding from the gingival, particularly upon touch. The histopathology of the necrotizing diseases is not pathognomonic for NG, and biopsy is certainly not indicated in the heavily infected area.

Differential diagnosis

NPD may be confused with other diseases of the oral mucosa. Primary herpetic gingivostomatitis (PHG) is not infrequently mistaken for NPD (Klotz 1973). Other oral mucosal diseases that have been confused with NPD are:

- Desquamative gingivitis
- Benign mucous membrane pemphigoid
- Erythema multiforme exudativum
- Streptococcal gingivitis
- Gonococcal gingivitis
- And others (e.g. some forms of leukemia)

All of these are clinically quite distinct from NPD.

Acute Stage of Noma

The first recognized and well-known sign of acute noma is edema of the cheek, gingival or both. Necrotizing stomatitis may be observed, generally starting at the alveolar margin in the premolar/molar region and extending to the mucosal surface of the cheek. This is rapid reaction (24-48h).
Within the next few days a discolored grayish-black area appears, on the external surface of the cheek opposite to the original introral lesion. It rapidly develops necrotic and remains remarkably well defined. The necrotic zone turns black and acquires a typical cone shape indicating the internal destruction of tissue is greater than the external lass of skin. The necrotic matter wich generally includes both soft and hard tissue, rap idly sloughs away. Inside the mouth, the alveolar bone gets exposed with exfoliation of teeth. Large sequestra of bone may form, but sometimes the necrosis is so profound that both maxilla and the mandible are totally destroyed *(Denise Baratti-Mayer et al 2003)*.
Noma is unilateral in most cases, but bilateral lesions are sometimes observed. General signs include anorexia, prostration, fetid odour, excessive salivation and occasionally local adenopathy. Pain and fever can also occur.
Secondary infection occurs rapidly and most children die at this stage, because of the starvation, respiration pneumonia or sepsis. The course of the disease is very rapid and death can occur only a few days after the onset of edema.

Sequelae

The healing of Noma lesions is characterized by fibrous scar that apparently reduce the cutaneous defect but often leads to definitive stricture of the mouth.
Other consequences are severe dental malpostion and salivary incontinence. When the maxilla is lost, there may be defective speech and nasal regurgitation. The only possible treatment at this stage is reconstructive surgery.
There have been many attempts to classify the lesions of Noma on the basis of the cutaneous defect. The classification that seems to be both the simplest and the most useful for the surgeon is that of Montadon and colleagues which has been adopted by WHO as the standard to describe defects caused by Noma (Fig11).
Type 1, localized cheek and commissural defect, is the most common appearance of Noma sequelae and is so typical that the origin of the mutilation can be diagnosed immediately. In occasional cases, it seems to be very minor problems, but surgeons should be aware that after the mouth has been opens, the contracture released and the defect corrected, the tissue loss can be much more extensive than initially assessed because the wound has healed by contraction. Type 1 is bilateral in some cases.
Type 2 includes the upper lip and in many cases the nose, the alveolar border and the palate. More rarely, an isolated nasal defect with loss of septum is observed.
Type 3 is mostly located on the lower lip and can sometimes include the complete mandible and floor of the mouth.

Type 4 covers major defect that may include the whole cheek, lips, the maxilla, the palate and the malar bone and which can in some cases extend to the eyelid and the nose. The frequency of this type is difficult to assess because most of the affected children die from meningitis or septicemia.

RISK FACTORS

Early descriptions of noma have cited malaria, malnutrition, measles, and poor oral hygiene as determinants in the aetilogy of the disease. All factors have a role in its pathogenesis and one or more may be found in most African children.
Any debilitating disorder can facilitate the progression of noma. These predisposing diseases include chickenpox, smallpox, typhus, typhoid fever, diphtheria, viral leichmaniasis (kala-azar), pneumonia, TB and more recently AIDS.

MALNUTRITION, INFECTION AND NOMA
(Enwonwu et al. 1999)

Health and disease are a reflection of a community it's behavior, and its environment. Previous studies had suggested that poverty was the most important risk indicator for Noma in sub-Saharan Africa with chronic malnutrition, very poor environmental sanitation, an unsafe water supply, and increased exposure to viral and bacterial infections as major predisposing factors. There is a strong association between malnutrition and Noma in Nigerian children. Enwonwu et al. proposed a tentative scheme to explain the pathogenesis of Noma in deprived Nigerian children (fig 1).As indicated in the scheme and extensively reported in the literature, a complex three-way relationship exists between malnutrition, immune dysfunctions in the host, and increased susceptibility to infections. Viral infections are more severe in the malnourished, and Beck MA 1996, has shown that malnutrition can alter the genotype of a virus, resulting in a more potent virus. *The interaction between viral infections, malnutrition, and diminished host resistance result in impaired oral mucosal immunity, local viral multiplication in the oral tissues, and selective growth of pathogenic bacteria.*

Endocrine function adaptations in malnourished African children usually include increased secretion of growth hormone, *cortisol*, and norepinephrine, with decreased production of insulin and the thyroid stimulating hormone. The mean plasma cortisol level in the well-fed control Nigerian children was within the lower range for published normal morning values, and **significantly much lower** than the mean levels in the

impoverished groups with and without Noma. The increased plasma concentrations of free cortisol in the impoverished children could be attributed in part to infections. Some infections, particularly gram-negative bacteria, viral, and fungal infections, are more frequent and severe in glucocorticoid-treated patients (Dale DC and Petersdorf RG 1973). *Glucocorticoid excess* enhances replication of a number of latent viruses (Glaser R et al.1994, Epstein J. 1993 and Scully C and Porter SR 1994), and promotes increased susceptibility of the oral mucosa to viral infections. Increased steroid levels in the mouth could also serve as a rich nutrient source of anaerobes (Loesche et al.1982).
Stress also impairs salivary gland function reducing the volume of saliva and the ability of salivary proteins. Studies of the effect of malnutrition on oral microbial ecology in Nigerian village children have demonstrated prominently increased recovery of spirochetes and anaerobic rods compared with control groups of well-fed children from the same ethnic background (Sawyer DR et al.1986).
Cellular depletion of key nutrients such as *zinc, retinol, ascorbic acid, and the essential amino acids*, will impair the structural integrity of the oral mucosa(King JC 1990, Filteau SM and Tomkins AM, Thurnham DI 1997 and Beisel WR 1996), thus creating easy portals of entry for the pathogenic microorganisms and their products(Enwonwu CO 1994, Bhaskaram P 1995).
The scheme (fig.1) of Enwonwu et al., proposes that viral infections acting in consent with malnutrition and the resulting selective overgrowth of pathogenic periodontal bacteria play a key role in the genesis of ANG in impoverished Nigerian children. Why a relatively few malnourished children with ANG should progress to Noma and the great majority do not is still unclear.
Jelliffe has proposed that an unknown **factor X** is responsible for the progression of ANG and/or other oral mucosal ulcers to Noma. According to Enwonwu's hypothesis it is believed that contamination by a consortium of microorganisms, of which ***F.necrophorum*** is an important member, constituted the factor X.
(Cases of Noma seen by Tempest MN occurred most frequently during the so-called hungry months in Nigeria.).

Poor oral hygiene

The role of poor oral hygiene in the aetiology of ANG has been studied intensively in children in less developed country, where toothbrush is largely unknown. Small numbers in urban areas use toothbrushes, in more rural areas the use of Siwak (chewing sticks) are preferred(Lawal kompendiet).Tiawo observed that ANG was present in 28% of 438 Nigerian children under the age of 12. She found out also of those with inadequate or bad oral hygiene had ANG 62% and 70% respectively.

Malaria

When Noma was still prevalent in Europe, xanthmous fevers, particularly measles, were recognized risk factors. In less developed countries, malaria has often been described as a risk factor for Noma. However, there is some debate about the importance of its contribution. Eckstein thought that malaria was the usual precursor of Noma (referanse!!)

He postulated that the major involvement of the reticuloendothelial system characterizing chronic malaria causes the loss of immunity that could lead to Noma. By contrast Tempest believed measles to be more important, and he found little evidence to suggest malaria as a risk factor for noma in West Africa (refreanse). Enwonwu mentions malaria as risk factor but, like Tempest, judged measles to be the most important debilitating disease preceding Noma.

Measles

Measles causes the death of more than a million children each year in less developed countries and has a major role in malnourished children.
Children with measles have a lower than normal energy intake and show low mobilization of hepatic vitamin A. In less developed countries, the disease can rapidly transform moderate undernutrition into kwashiorkor or marasmus with fatal outcome in most cases. African children affected by measles, also present with ulcerative lesions of the oral mucosa, which can be so destructive that they have been termed "noma-like post-measles ulcerations". Theses can easily progress to noma owing impaired tissue repair resulting from vitamin A deficiency.
These observations were made also in Europe in the 19th centaury.
In vitro studies have proved that the presence of morbiliivirus in mono nuclear cells diminishes cell-mediated immune response and has a temporary effect that is similar to the definitive immunosuppression occurring in AIDS. The measles virus can act by direct cytotoxic effect on activated T cells and reduces the productions and activations of interleukins, particularly interleukin 12.
Immunosuppression during measles can also result from additional and combined mechanisms, whether they can facilitate the occurrence of noma remains unclear.
Although measles is believed by some to be important risk factor for noma, many cases of noma have been documented among children with no recent history of measles. The casual relation and pathophysiology pathways linking measles, immunology and ANG or even noma remains speculative.

PATHOPHYSIOLOGY

Vascular theory: Given the cutaneous necrosis in noma is very well demarcated and self-limiting; an ischemic mechanism with located arterial thrombosis or capillary microthrombosis could be the explanation. However, the importance of the facial vascularization and striking separation between deep and superficial networks exclude a hypothesis such as an arterial thrombosis. Moreover, there is no anatomical relation between the lesion observed and the vascular topography. Capillary microthrombosis could have a role but is probably secondary to infection.

BACTERIAL MICROBIOTA OF NOMA

The bacterial etiology of Noma has not been firmly established. It has been suggested

that Noma results from a mixed infection of oral and extraoral opportunistic pathogens. Spirochetes and species of Fusobacterium have long been suggested to play a role in the disease process. Based on early ultrastructural studies, a long filamentous, gram (+) rod and spirochetes were implicated as potential etiologic agents of Noma. More recently, it has been proposed that at least certain cases of Noma result from a zoonotic infection with Fusobacterium necrophorum, an etiologic agent of foot rot in sheep and other livestock.
Nineteen species or phylotypes were detected in several subjects. (Fig. table 1)
Additional known oral species that were detected in some of the subjects include Capnocytophaga spp., Eikenella corrodens, Fusobacterium spp., Gemella haemolysans, Neisseria spp., and Streptococcus spp. Many of these species have been associated with periodontal diseases. In general, the microbiota of Noma lesions was comprised of species not commonly associated with periodontal disease or health. Since these advanced Noma lesions were infections open to the environment as well as under unsanitary conditions, it was not surprising to also detect species not commonly associated with oral cavity. Species of Flavobacterium, Microbacterium, Sphingomonas, Bacillus, Paenibacillus, and Rhizobium are widely distributed in the environment, e.g., soil, and rarely cause infections in humans. Fusobacterium spp. has long been associated with Noma infections. Recently, F.necrophorum, an opportunistic pathogen that causes numerous necrotic conditions, was recovered from 7 of 8 advanced Noma lesions.
Authors then believe that Noma may be a zoonotic infection caused by F.necrophorum since the infected children were in close contact with livestock (i.e., they eat and sleep with their animals) (Falkner, Enwonwu and Idigbe 1999)
There was a notable absence of other species that one night expect to see in there infections, such as Actinomyces spp., Streptococcus intermedius, and those species commonly associated with Noma infections, but are observed at lower levels compared to other organisms. This may have something to do with that many organisms in advanced infections have had the opportunity to proliferate and potentially mask the presence of putative etiologic agents.

Viral theory: An interesting viral theory of noma suggests that with infection with herpes virus could lower local immunity, thus facilitating the development of pathogenic bacterial flora. This hypothesis was originally concerned with the aetiology of ANG but later extended to noma.

Among the herpes virus, cytomegalovirus is the most frequently associated with periodontal disease. At the time of primary cytomegalovirus infection, the ratio of CD4+ to CD8+ cells is inverted; wich may explain the high frequency of secondary of bacterial or fungal infections. Cytomegalovirus can also friectly infect polymorphonuclear neutrophils and interfere with their function. Cytomegalovirus infection can cause an increase of interleukin 1β, a potent bone resorptive cytokine which is thought to have a role in periodontal diseases. In less developed countries, cytomegalovirus infection occurs at the same age as the appearance of ANG and acute noma.

Elements of plausible noma etiology could include: a predisposing condition with all abovementioned risk factors, a primary infection with cytomegalovirus or another herpes virus, a lesion of gingival mucosa barrier, the postulated being ANG and unrecognized bacterial factor acting as trigger for the development of the noma lesion.

EPIDEMIOLOGY

(Denis M. Bourgeois, Diallo, Friech and Leclercq 1999)

Noma is a disease that is prevalent in poor rural communities of the third world. Noma patients are the poorest of the poor. The children come from illiterate farming and nomadic families. As many as 70-90% of these with Noma die, and to date, there is no satisfactory treatment to fight this disease. The mortality rate of the patients that were not treated was approximately 90%. A total of 96.9% of the patients with acute diseases had poor general health with serious associated diseases.

The epidemiology of Noma is poorly understood, making the development of prevention strategies difficult. No epidemiologic study have been published during the past two decades; data date back mainly to the period 1950-1965. Furthermore, there has not been any formal surveillance system set up for Noma. However, a few cases of Noma have been reported in the last 20 years in most developing countries, especially in Africa. The WHO has been expecting the emergence of a Noma-affected zone in sub-Saharan countries, with a possible annual incidence estimated between 2 and 5 cases per 10,000 children 0-6 years of age. Since 1991, WHO has recorded cases of Noma in 23 countries (Bourgeois et al. 1999).

The World Health Report 1998 gives a global incidence of Noma of 140 000 cases and a prevalence in 1997 of 770 000 persons surviving with heavy sequelae (Bourgeois et al 1995).

Barmes et al. estimated a case incidence in Nigeria of 1:1250, and a case incidence in Niger and Senegal of 1:34, respectively 0.7-1.2 per 1000 children aged 0-6 years. Because Noma is not restricted to the regions south of the Sahara, but is also present in other parts of Africa and in other continents, the global incidence of Noma can be roughly estimated as 30000-40000.(Fieger et al.2003) fig.table2 : Age distribution of Noma onset (Noma in North-west Nigeria) (Frieger et al.)

TREATMENT

Prophylaxis: Avoiding malnutrition and infections as a result of poverty must be the key to preventing Noma. Public health campaign for improving oral health should be very useful.

Acute phase: Management of this stage consist of attempts to improve overall health status by rehydration, nutritional rehabilitation, administration of vitamin (especially vit A), and treatment with antibiotics. Broad spectrum antibiotic therapy covering mostly aerobic and anaerobic periodontal and oropharyngeal flora is generally recommended in the absence of definitive data on specific pathogens. Improved oral hygiene has to be introduced as soon as local conditions permit, and the adverse effect of poor hygiene have to be gently removed. However, invasive intraoral intervention has to be avoided because of the risk of precipitating evolution of the lesion. In particular, extractions are possible only for teeth that are already loose. Reconstructive surgery is also prohibited in the acute phase and cannot be undertaken until the lesion are well demarcated and healing complete. Importantly, during the healing phase characterized by fibrous scarring leading to definitive stricture of the mouth, physiotherapy should be started promptly and should continue after surgery to prevent recurrence of the constricture (fig 12).

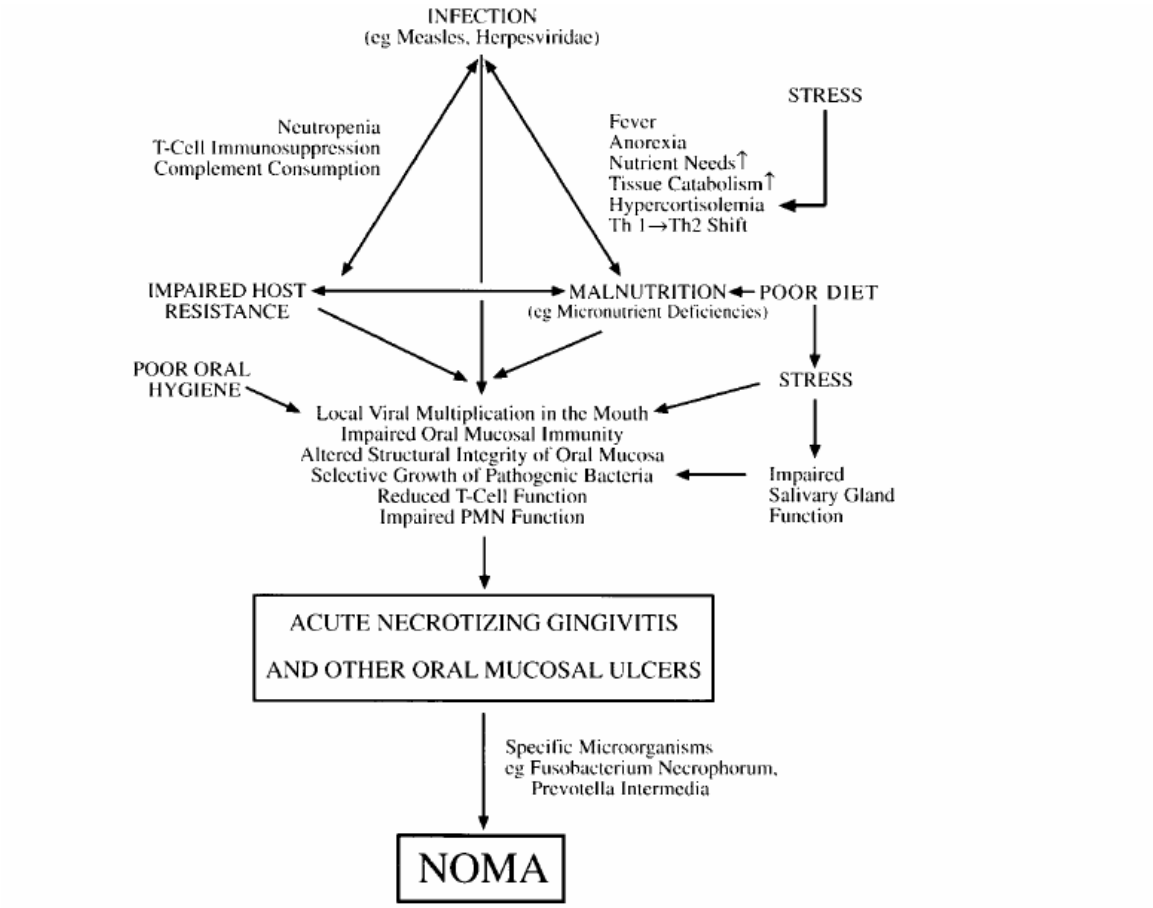
Surgery: The correction of deformities after noma is one of the most challenging problems for plastic and reconstructive surgeons. The children and young adults affected by the disease can later show all kinds of disfigurement, each case requires an individual approach, and there is no standard surgical procedure.
At the end of the acute phase, the necrotic tissues may slough spontaneously, but in many cases debridement of the wound is necessary to avoid secondary infection and to accelerate healing. Wound contraction can lead to mouth stricture, which can progress to complete closure of the mouth aperture with interwining teeth bony fusion between the maxilomalar complex and the mandible, a condition extremely difficult to correct

surgically. Prevention of these contractures by conservative measures can greatly contribute to final outcome (fig 12).
Reconstructive surgery is rarely considered earlier than a year after the onset of the disease, except when sequelae prevent an adequate nutritional intake. Since most patients live in very poor countries with inadequate medical facilities, an initial selection has to made between the cases with minor deformity that can be corrected on site by local surgeons or during surgical missions, and severe cases for which sophisticated surgical environment will be needed to obtain satisfactory result and avoid severe and even life threatening complications. This selection can generally be made by an expert surgical team using records that include photograph of the patient, the degree of mouth aperture, age, general condition and co-morbidities.
When first seen the patient undergoes a thorough clinical, and if necessary, radiological examination so the stage of the disfigurement, the amount of true bone and soft tissue loss, dental state, and degree of mouth stricture can be assessed. An action plan is drawn up by the surgical team, which includes the choice of procedures to be carried out, the type of intubation, and the time schedule of the various interventions. Most operations have to be done under general anesthesia and intubation is required. For mouth stricture, tracheostomy can be avoided by the use of fibroscopic intranasal intubation.

Moreover, since most patients are children, special care and planning are indicated. Although the pathology is very varied, the treatment strategy includes the following. First the mouth contracture must be released by removal of scar tissue. Excision of a hypertrophic coronoid process of mandible may be necessary. In the case of maxillomandibular synostosis, a horizontal large bone fragment must be removed to release the constriction.
Second, if bone has been destroyed, a vascularised bone flap is generally necessary the problem should be addressed initially.
Third, soft tissue reconstruction and aesthetics refinement are carried out during subsequent operative steps. When required, a flap can be prefabricated, or a skin expander inserted under the forehead as first procedure. No precise guideline can be advocated for each type noma sequelae, because every case differs.
As in any type of surgery, reconstructions for noma sequelae may involve complication such as wound infection and flap necrosis, as well as those that can follow extensive and complex surgical procedure under general anesthesia. If not chosen and treated correctly, the donor sites of flaps or grafts may be more disfiguring than the original lesion. In all cases, follow-up for at least 2 years is necessary for assessment of the result of the surgical treatment.
Furthermore, the long term benefit of surgery cannot be guaranteed without a close collaboration with noma centers in developing countries to ensure postoperative physiotherapy and social reintegration and to coordinate on site visits by surgical team.
The main objective of reconstructive surgery of noma sequelae is to restore a human face and to allow noma victims to reintegrate in normal social life. Common examples are the ability to attend school, to get married, or to learn skill (Fig.12 + 13).

CONCLUSION

Noma is an infection affecting the face causing disfigurement, functional impairment and never the less death because of sepsis. The mortality rate is estimated to be up to 90%. Now a days victims are mainly young children. The sequelae of Noma are well known but the initial stage of the disease remains difficult to characterize.
The latest and present expert consensus is that ANG is a precursor of Noma. Risk factors are believed to be malaria, malnutrition, measles and poor oral hygiene. Among these predisposing diseases includes chickenpox, smallpox, typhus, typhoid fever, diphtheria, viral leichmaniasis, pneumonia, TB and AIDS. In an acute Noma the first and well known sign is edema of the cheek and/or gingival. Fever, apathy, gingival bleeding, lesions of the oral mucosa and fetid odour can also be present at this stage. The course of the disease is very rapid and death can occur only a few days after the onset of the edema.
The interaction between viral infections, malnutrition and diminished host resistance result in impaired mucosal immunity which according to Enwonwu et al. cause selective overgrowth of pathogenic periodontal bacteria and plays and plays an important role the genesis of ANG in impoverished children. It is still unclear why only a few of these malnourished children with ANG should progress to Noma and the majority do not.
Affecting risk factors like malnutrition, (viral) infections and poor oral hygiene should be enough to prevent ANG → Noma.



Proposed schematic representation of the pathogenesis of cancrum oris (noma). Th = T helper cell; PMN = polymorphonuclear

Figure 1

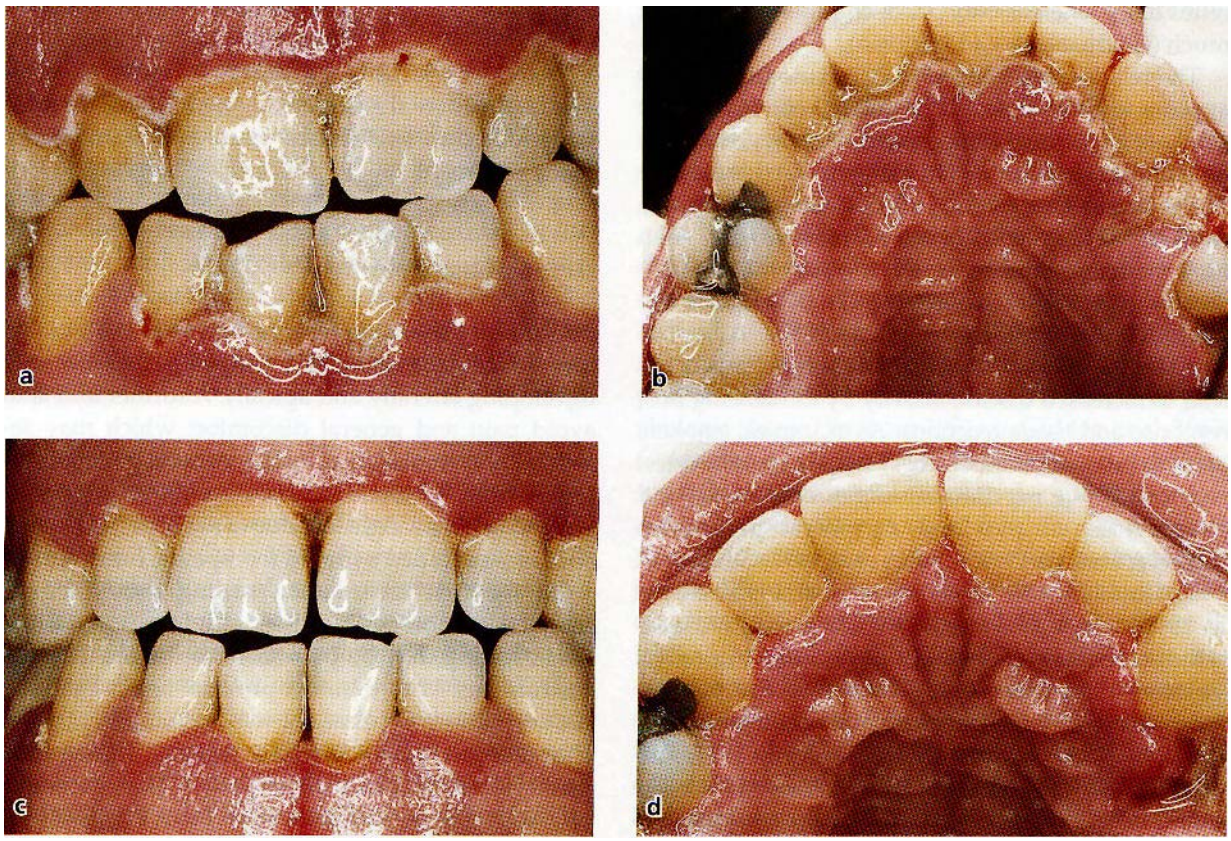


Figure 2(a, b, c, d)

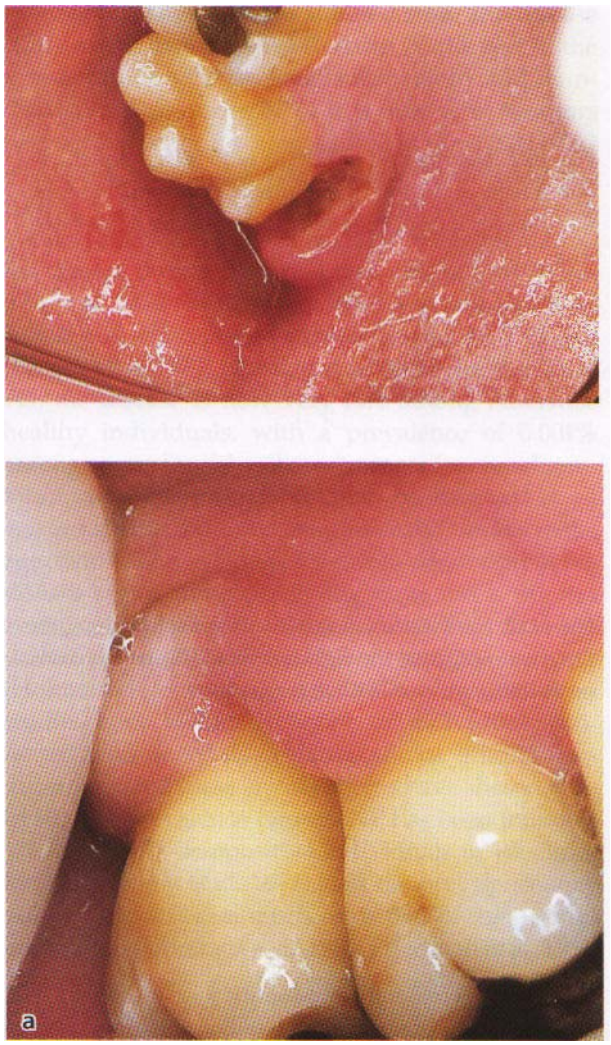


Figure 3(a)

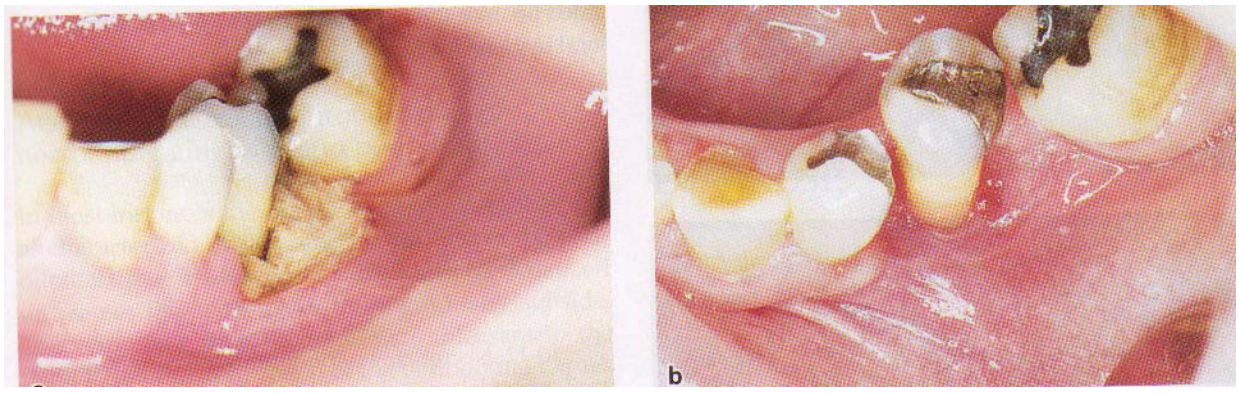


Figure 4(a, b: after treatment)

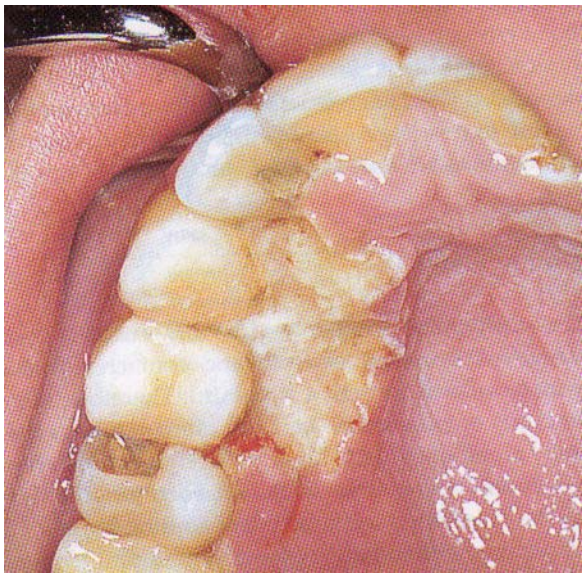


Figure 5

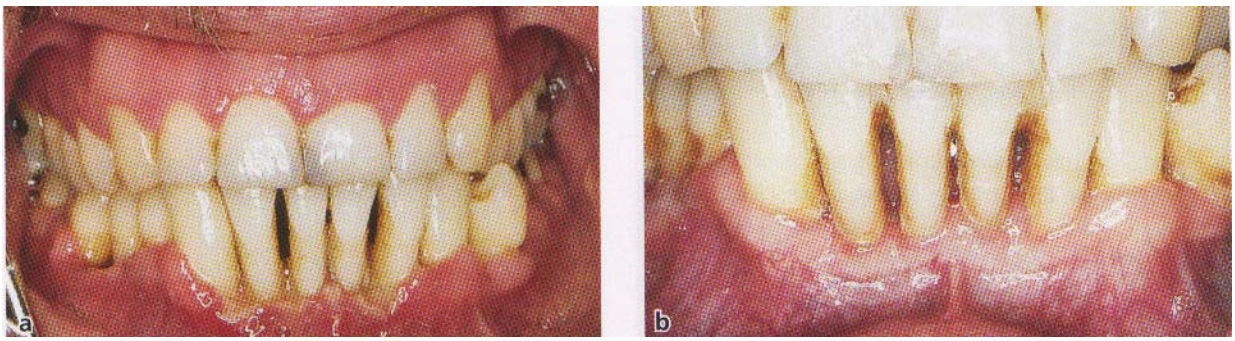


Figure 6(a, b)

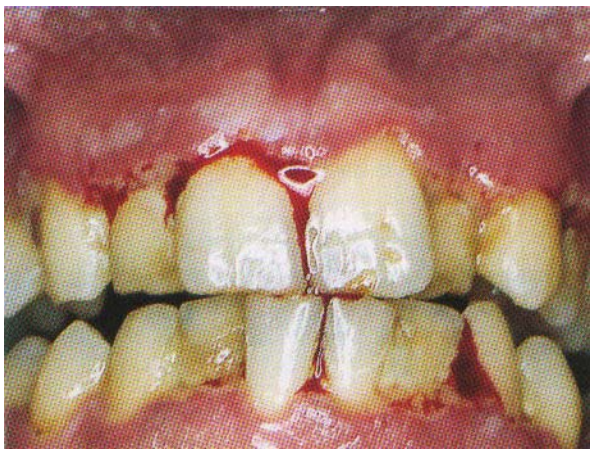


Figure 7

Figure 8

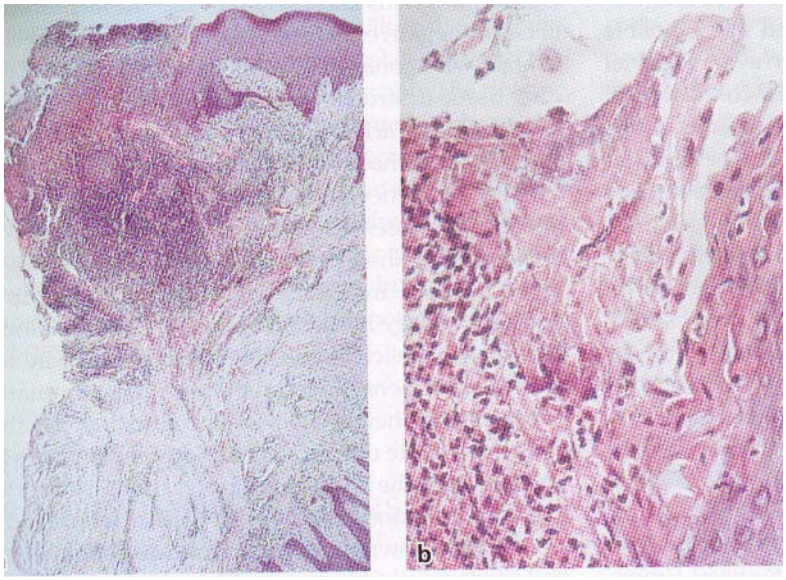


Figure 9(a, b)

Figure 10

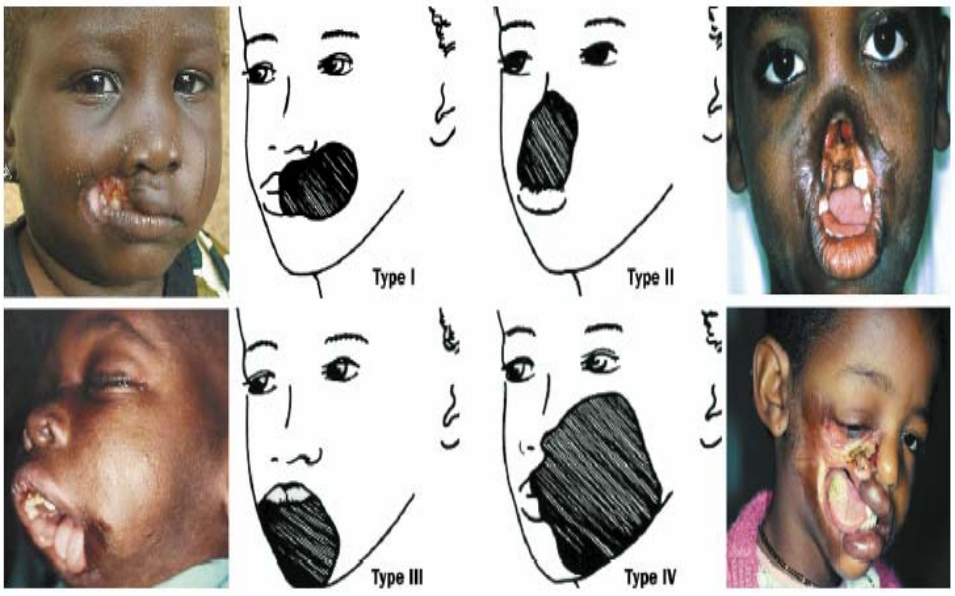


Figure 11(Defect 1-4)

Table 1 (list) (Distribution of prevalent species or phylotypes in Noma subjects. 19 prevalent bacteria)

No. of clones detected in subject:

Species or phylotype	N= 94	N=90	N=19	N =9
Achrombacter xylosoxidans	9	1		
Afipia genomospecies 8	2	2		
Bacillus fusiformis		2	3	
Brevundimonas diminuta	1	6		
Leptothrix strain DhA-71	1	1		
Noma clone AW149	1	1		
Noma clone BZ008	1	1		
Noma clone CA004		1	1	
Ochrobactrum anthropi	11	5		
Oral clone AY017	1	1		
Oral clone AY088				
Oral clone AZ002	2	1		
Oral strain A08KA	14	1		
Propionibacterium acnes	1	1		
Rhizobium loti	1	1		
Sphingomonas strain JSS-28	1	3		
Staphylococcus aureus		2	2	
Staphylococcus epidermidis	1	1		
Stenotrophomonas maltophilia	29	1		1

Table 2 Age distribution of noma onset

Age of onset (years)	Number of noma patients
0–1.5	21
2	126
2.5	5
3	83
4	32
5	28
6–9	36
10–15	10
16–19	3
20–29	1
30–39	2
40–49	1
>49	0
Blank	30
Total	378

Figure 12 (Fig 6A)

Figure 13 (Final Picture)

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